Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

EMBRYOLOGY.

The Continuity of the Primary Matrix of the Scales and the Actinotrichia of Teleosts.—In *Batrachus tau,* if transverse sections are prepared from embryos a few days after hatching, it will be found that a basement membrane underlies the whole of the epidermis, as an extremely thin layer. This layer of homogeneous matter covers the entire larval fish, and is interposed between the organs of mesoblastic origin and epiblast everywhere. In the fin folds there are linear and parallel thickenings of this thin lamina of basement membrane which eventually become the actinotrichia, as I have named the primary fibrous rays of all fishes. The mesoblastic cells which aid in developing the actinotrichia have a disposition to lengthen in a direction parallel to the latter.

The membrane over the rest of the body is continuous in Batrachus, and doubtless represents the matrix of scales in other forms. Its continuity shows that the matrix of scales was probably originally continuous in all fishes, and that the lateral bendings of the body in locomotion have been in part the efficient cause of the segmentation of the continuous layer, into, at first, oblique bands as in Callichthys, and then into lozenge-shaped tesseræ. These bands doubtless conformed in direction at first, in some cases, to the underlying muscle plates Later secondary modifications introduced other complications.

This evidence is at any rate highly interesting as pointing to the conclusion that the primary basis of the exoskeleton of fishes is conclusious, so as to form an unbroken cuticular investment of the entire mesoblast.

It also affords striking confirmation of my hypothesis[1] that the exoskeleton is to be traced phylogenetically to an uninterrupted cuticular or basement membrane occupying the position of the mesoglœa in cœlenterates such as the Medusae and Hydroids.

Aggregations of this cuticular membrane constitute the basis of the "cementum plates" of the teeth of fishes. The ganoin and variously modified enamel of ganoid scales is a derivative of the epidermis proper. The cementum plates grade very gradually into the various types of osteodentine, and into that form of dentine with ramifying tubules seen in some ganoids and known as cosmin. Such aggregations or local thickenings of the cementum have arisen in the first place as the con sequence of the local aggregation in groups, due to local stimulation, of the underlying connective tissue cells.

---

[1] A physiological theory of the calcification of the skeleton. Proc. Am. Philos. Soc., Vol. XXVI, 1889.

The Teleosts accordingly still bear traces of having a great capacity for developing the matrix of a protective dermal skeleton ; far greater than in other types. In birds, mammals, reptiles, and batrachia, of a corresponding larval stage of development, the continuous cuticular or basement membrane beneath the epidermis, is either entirely wanting, or is never developed except locally at relatively much later stages.

There is also evidence to show that with the progress of evolution this primary superficial matrix has tended to be carried inward toward the cartilage so as to form the membrane bones, particularly on the head. Yet there are other regions where an engulfing of the superficial subepidermal calcifications in membrane occurs during the life of the individual. In the common sturgeon the preanal scales or scutes are superficial and exposed, except for their very thin covering of epidermis ; in the adult, on the contrary, these scales are so deeply embedded in the tissues as to be completely lost to sight externally, and lie so far below the epidermis as to be exposed only by recourse to the scalpe It is this peculiar circumstance that has given rise to the erroneous belief amongst ichthyologists that some of the abdominal scales of the sturgeons were "deciduous."

The continuous investment of the mesoblastic tissue of the larvæ of recent scaleless Teleosts, such as Batrachus, by a structureless basement membrane which can be identified with a true scale matrix shows how persistently the armature of the Devonian types still tends to be inherited, even by a form not developing true scales. It is probably a good illustration of what Eimer means by his theory of "constitutional impregnation," or, as one might say, saturation with inherited tendencies.

With the advent of the body-cavity, gut-pouches, and mesoblast of triploblastic types, the mesoglœa of the diploblastic type would be divided, that is to say, some of the matrix would be deposited upon the functionally inactive (in digestion) derivatives of the intestine, such as the notochord, while some would be deposited by the same secretory activity of the mesoblast upon the inside of the epidermis. This division, determined by purely physiological agencies, therefore gives both the matrix of the endoskeleton and that of the exoskeleton. The active translation of new matters, or metabolism, through the intestinal walls prevents the deposit of any cuticular membrane there, and it is only over the ametabolic notochord, which is an indirect derivative of the intestine, that such a deposit can take place.

The actinotrichia are at first joined together by a thin cuticular membrane; later, they separate more widely, and the intervening membrane between the actinotrichial fibres disappears. The latter also are not round at first, but flattened, or oval in cross-section. Their greatest diameter also corresponds to the direction of the plane of the membrane of which they form a part.

To the proximal ends of the two rows of actinotrichia the fin muscles were originally attached, as may still be seen in sharks, Dipnoans and Chimæroids. This insertion of the fin muscles, their serial action from before backward, as well as the necessary undulatory motion of the tail from before backward in the act of locomotion, must throw the fin folds into a lateral undulatory motion from before backward. This undulatory motion would tend to favor the breaking of the cuticular membrane under the epidermis of both sides of the fin into parallel threads, owing to the short flexures into which its substance must be thrown. In this way the genesis of the actinotrichia themselves may be traced to the direct action of physical causes. The subsequent cross-fracturing of the rays derived from a further development of the actinotrichia, I have elsewhere proved to be due to the interaction of the organism and the resistance offered by the surroundings to the motions of the fins.[1]

The thickness of the continuous subepidermal basement membrane in Batrachus, also varies in a singular and suggestive way. It is decidedly thicker on the dorsal aspect and on the upper portions of the sides of the body, and thinnest on the ventral aspect which is most protected in this form, which, as is well known, lives by preference at the sea-bottom resting on the mud.

In the earlier forms of fishes, such as Coccosteus, Mycterops, Pteraspis, Cephalaspis, etc., there was a tendency to form an unbroken dorsal cephalic shield. This tendency is still preserved in the evolution of the cranial plates of the sturgeon on the sides and top of the head, and is expressed on the body, in that the dorsal scutes are always the first to be developed. The development of the cranial exoskeleton in primitive forms, and in now existing types representing the latter, therefore coincides with this early appearance of traces of the superficial skeletal matrix in a subepidermal position on the dorsal aspect of the head and body in the existing larvæ of unarmored forms, which may be supposed to have lost such a defensive exoskeleton. The parallelism here pointed out is, at any rate, extremely suggestive, and if capable of further demonstration will show how persistently an extremely ancient character tends to be inherited. JOHN A. RYDER.

---

[1] Proofs of the effects of Habitual use in the Modification of Animal Organisms. Proc. Amer. Philos. Soc. Vol., XXVI., 1889.